Fishes Killed by the 1950 Eruption of Mauna Loa, Part V
Gonostomatidae

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AMONG THE DEEP-SEA FISHES collected at the surface during the Mauna Loa lava flow into the sea in 1950 were 30 small specimens belonging to the family Gonostomatidae. Of the 5 genera and 5 species represented, 2 of the genera (1 of them new) and all of the species (1 or 2 of them new) were hitherto unknown from waters around the Hawaiian Islands. Gosline *et al.* (1954) described the lava flow and the methods of collecting. I am indebted to Dr. Gosline for permission to report on these specimens, and to Dr. Rolf Bolin for relinquishing his prior claim to them.

Gonostoma atlanticum Norman

MATERIAL EXAMINED: 1 specimen, 59.5 mm. in standard length, collected off the Mauna Loa lava flow, Hawaii, by Moore *et al.*, June 3, 1950.

One specimen, 47 mm. in standard length, collected off the Mauna Loa lava flow, Hawaii, by Yamaguchi, June 6, 1950.

Three specimens, 58.5, 54, and 49 mm. in standard length, collected off the Mauna Loa lava flow, Hawaii, by Gosline *et al.*, June 6, 1950.

Counts and measurements given in order of diminishing size, largest specimen first. Dorsal rays 17, 17, 18, 18, 16. Anal rays 28, 29, 29, 28, 28. Pectoral rays 10. Ventral rays 6. Gill rakers on first arch 11 + 6, 11 + 6, ? + 6, —, 11 + 7. Photophores: BR 9; IV 16; VAV 5; AC 19 (partially lost in smallest specimen); IC 40; OA 13.

Per cent of standard length (59.5, 58.5, 54, 49, 47 mm.): depth 16.8, 17.1–17.9, 16.7–17.6, *ca.* 18.3, 18.0; head 24.3, 25.6, 25.0, 24.5–25.5, 25.5; snout 4.2, 4.27–5.12, 4.62, —, 4.25–5.3; orbit 4.2, 4.27, 3.5–4.62, —, 4.25; interorbital width at center of eye 3.36, 3.42–4.27, 3.5–4.62, —, *ca.* 4.25; upper jaw 18.5, 19.6–20.4, 20.4, 19.4–20.4, 20.2–21.2; premaxillary 3.36, 4.27–5.1, 4.62, —, 5.3; toothed portion of maxillary 14.3, 15.4, 15.7, —, 15.9; tip of snout to dorsal origin 58.0, 58.9, 58.4–59.2, 58.1–59.1, 59.5; to anal origin 56.3, 57.2, 56.5–57.4, 56.1, 56.4; to ventral bases 46.2, 48.6, 46.2, 47.8, 46.7; distance between anal origin and caudal base 41.1–42.0, 42.7, 41.6, 42.7, 42.5; between last anal ray and caudal base *ca.* 10.1, *ca.* 10.2, 10.2, —, 10.6; between last dorsal ray and caudal base *ca.* 23.5, *ca.* 22.2, 22.2–23.1, —, *ca.* 23.4; between inner insertion of ventral and origin of anal *ca.* 8.4, 9.4, 7.4–8.3, —, *ca.* 7.45; least depth of caudal peduncle 5.8–6.7, 5.97–6.83, *ca.* 5.5, —, 6.38; dorsal base 16.8, *ca.* 17.1, 17.6, —, *ca.* 17.0; anal base 31.9, 32.4, 33.3, —, *ca.* 32.0; pectoral length —, 17.1, 16.7, —, 12.75; ventral length *ca.* 7.56, 6.83, 7.4, —, 6.38.

Skin partially lost in all specimens. Only a few scales remaining, mostly over photophores, but well-preserved scale pockets indicating that back and tail, at least, were fully clothed with large, thin, cycloid scales. Pectoral fins reaching as far as 12th or 13th IV photophore. Ventral fins reaching anus. Most specimens with 13 long teeth on maxillary (only 9 or 10 in 2 specimens reported by me in 1960 from the Marshall Islands) and apparently no posterior pterygoid teeth. Three largest specimens with 3 palatine teeth, increasing in size posteriorly. A small reflector present behind ORB in only 1 specimen (47 mm.). Only two largest with small glands visible below OA. All 5 specimens with a single pale yellowish infracaudal gland at base of posterior procumbent caudal rays; possibly a second one originally existed anterior to it. Two well-developed supracaudals with the outward appearance of large photophores, being surrounded on sides and lower surface by blackish brown pigment.

Color blackish brown, head and abdomen darker, cheeks silvery or iridescent and with black puncticulations, peritoneum black, oper-

[1] Chicago Natural History Museum, Chicago, Illinois. Manuscript received December 19, 1960.

cular linings brown, inside of mouth pale anteriorly and brown posteriorly.

Largest specimen (abdomen damaged), a female with large ovaries.

Counts and measurements are in close agreement with those found in published descriptions of this species. The body depth is possibly somewhat greater in Hawaiian specimens and the count, in one, of 11 + 7 gill rakers is unique.

These specimens represent the second Pacific record of *G. atlanticum*. The first capture was in the Marshall Islands area (Grey, 1960). The species is probably more widely distributed in the central portions of the Pacific Ocean than is known at present.

Cyclothone sp.

MATERIAL EXAMINED: 3 specimens, standard length *ca.* 20.5, *ca.* 23, and *ca.* 23.5 mm., collected off the Mauna Loa lava flow, Hawaii, by Moore *et al.*, June 3, 1950.

Specimens all in poor condition; following characters common to all: first VAV very close to ventral base, anus directly below it; VAV evenly spaced; color pale brownish, abdomen darker, myomeres outlined in darker pigment; on 1 specimen a shred of skin with a few black spots remaining, its original position on body not determinable; 2 narrow vertical brown bars at extreme end of caudal peduncle, 1 above mid-line and 1 below mid-line; dashes of internal pigment at end of caudal peduncle; a series of 6 internal brown spots along base of dorsal fin and 18 along anal base; ventral portion of body between ventral and anal fins, below musculature, entirely colorless and transparent, the VAV photophores situated in this region; branchiostegal membrane with a narrow brown line at base and a broken line of brown pigment on edge, otherwise colorless; a bar of brown pigment curving down from pectoral base and extending forward on isthmus.

Specimen *ca.* 23.5 mm.: BR 8; VAV 4, possibly only 3 (fourth at first anal ray). IV, AC, and OA all lost or damaged. Maxillary teeth subequal, becoming gradually larger posteriorly, first one not larger than those immediately behind it.

Specimen *ca.* 23 mm.: BR 8, IV 13. VAV 4, possibly only 3 (fourth at first anal ray). AC and OA mostly lost. Dorsal rays probably 12, anal rays probably 19.

Specimen *ca.* 20.5 mm.: BR 7. IV and VAV mostly lost. AC 9 or 10, last one on caudal base. Last two VAV present, last at anal origin; if this photophore belongs to the AC series, the total number is 10. Gill rakers on first arch 9 + 1 + 3 = 13, only 1 in angle. Vomer toothless. Palatines and pterygoids each with 3 microscopic teeth. Ventral fins undamaged, reaching to or slightly past anal origin.

Both the poor condition of the Hawaiian specimens and the uncertain taxonomic status of species of the genus *Cyclothone* Goode and Bean prevent positive identification of these specimens. They are allied to *C. signata* Garman and *C. alba* Brauer (pale coloration, a single gill raker in the angle of the first arch, no vomerine teeth) and are possibly identical with *C. alba*. However, *C. alba* was described with an AC count of 12 or 13, similar to that of *C. signata*, and the AC number is only 9 or 10 on the only Hawaiian specimen on which these photophores are preserved. The total number of gill rakers on the first arch is similar in all 3 forms, 13 in the 1 Hawaiian specimen on which they can be counted, 14–15 in *C. signata* and *C. alba*. *C. alba* and the Hawaiian specimens have 7–8 BR photophores, in contrast to the 9 or 10 of *C. signata*. Both the first VAV photophore and the anus of the Hawaiian specimens are extremely close to the ventral bases. In *C. alba* these were figured by Brauer (1906: 80, fig. 30) as being placed somewhat more posteriorly. However, in specimens examined from the Atlantic (Florida), probably identical with *C. alba*, the first VAV is also closer to the ventral bases than shown in Brauer's figure and this character may be a variable one.

Although it is no surprise to learn that a light-colored *Cyclothone* inhabits Hawaiian waters, the only species of the genus hitherto reported from the area have been the dark-colored forms *C. atraria* Gilbert and *C. canina* Gilbert.

Araiophos, NEW GENUS

TYPE SPECIES: *Araiophos gracilis*, new species.

Eye normal, large. Snout shorter than orbit. Interorbital width at center of eye less than diameter of orbit or length of snout. Mouth

FIG. 1. *Araiophos gracilis,* holotype, standard length 34 mm.

moderate, oblique; edge of premaxillary straight, its angle oblique; toothed edge of maxillary slightly convex, reaching beyond middle of eye but not as far as its posterior margin. Premaxillary about half as long as toothed portion of maxillary. Angle of preopercle almost vertical. All teeth minute, not numerous, uniserial in upper jaw; lower jaw with an outer row of 3–4 teeth anteriorly. Presence or absence of teeth on vomer, palatines, pterygoids, and tongue not determinable. Gill rakers on first arch 15 + 3 = 18 (1 specimen), 2 in angle. Minute (microscopic) clusters of spines on inner edge of first gill arch. Presence or absence of pseudobranchiae not determinable. No evidence of scales. Anus about half-way between ventral bases and anal origin or slightly nearer the former. Head and trunk about equal in length to tail or slightly shorter. Origin of dorsal fin well behind middle of body length. Anal origin and ventral bases well ahead of dorsal origin. Adipose fin present. ORB 1, in front of eye, close to premaxillary. OP 1 (lower posterior), level with end of maxillary. SO absent. BR (6). No additional photophores on head. Body with a single row of photophores; photophores present on isthmus. IV (2) on isthmus, + (3) + 4 + (2) = 11. VAV (4–5). AC (2) + 3–4 + (2) = 7–8. IC 22–23. No additional photophores and no luminous tissue on body as far as known. Fin rays: dorsal 13–14, anal 28–29, pectoral (15?) 16–17, ventral 6. Branchiostegal rays 8, no spines at bases. Number of vertebrae unknown.

Araiophos differs distinctly from all other maurolicid genera in the reduced number of photophores. Only in the BR count of 6 and the VAV count of 4 or 5 is it similar to others (*Valenciennellus* Jordan and Evermann also has 4 or 5 VAV and several genera have 5). The small number of photophores might be a juvenile character and the absence of photophores between the isthmus and the posterior end of the pectoral base (where in some species they are known to develop late), the absence of 2 of the OP, and the small size of the ORB, give support to the possibility that all of the specimens studied are young. On the other hand, although the specimens range in standard length from a little over 21 mm. to 34 mm., the number and relative size of the photophores are identical in all. If more were to develop, on the body at least, one would expect to find the smallest specimen differing somewhat from the largest. The presence of gonads is also significant and the obvious implication is that *Araiophos* provides another example of neoteny among fishes. Even were the specimens still juvenile they could not be shown to belong to any known genus. Only in *Maurolicus* Cocco is the dorsal fin situated so far behind the middle of the body length; and the Hawaiian specimens cannot belong to *Maurolicus,* in which the developmental stages are well known and which has acquired all of the meristic characters of the adult at a length of about 20 mm. Nor is it likely that the Hawaiian specimens represent a metamorphosis stage of some known genus; as far as we know the development of maurolicid genera is direct and none are known to undergo a metamorphosis

stage with changes in body form or fin positions.

An attempt to modify the diagnosis of one of the known genera to accept this new form has been unsuccessful. Several characters align it with *Thorophos* Bruun and *Neophos* Myers: relative positions of dorsal and anal origins; number of gill rakers; elongate body form; IV photophores on isthmus straight, none curving upward toward pectoral base; VAV not reaching anal origin. The lack of OA photophores, if not a juvenile character, is an additional point of resemblance between the new genus and *Neophos,* which has only 1 OA. However, in both *Thorophos* and *Neophos* the angle of the gape anteriorly is much more acute than that of *Araiophos,* and in *Neophos* and *Thorophos* the gape is wider, the maxillary reaching to or beyond the posterior margin of the eye (only slightly past the middle of the eye in *Araiophos*). In fin ray counts *Araiophos* is closest to *Argyripnus* Gilbert and Cramer, and to *Maurolicus;* and only in the latter, among maurolicid genera, is the dorsal origin situated well behind the middle of the body length as it is in *Araiophos.*

Derivation of name: *araios,* Gr., 'few'; *phos,* Gr., 'light.'

Araiophos gracilis, new species
Figs. 1–3

HOLOTYPE: Standard length 34 mm., collected off the Mauna Loa lava flow, Hawaii, by Gosline *et al.,* June 6, 1950.

PARATYPES: 9 specimens, standard length 30.5, 24, and 23 mm. (3 specimens); length from tip of snout to base of caudal fin 31.5, 28, 27.5, and 26.5 mm. (5 specimens, lower jaws broken), and *ca.* 21 mm. from nape to base of caudal fin (1 specimen, head lacking), collected off the Mauna Loa lava flow, Hawaii, by Moore *et al.,* June 3, 1950.

Dorsal rays 13–14 (holotype 14). Anal rays 28–29 (holotype 29). Pectoral rays 16–17 (holotype 16, possibly only 15). Ventral rays 6. Branchiostegal rays 8. Gill rakers on first arch 15 + 3 = 18 (holotype only), 2 in angle.

Measurements of holotype expressed in per cent of the standard length (34 mm.), followed in parentheses by similar measurements of 2 specimens 31.5 mm. from tip of snout to caudal base and 30.5 mm. in standard length: depth 13.2 (12.7, 13.1–14.7); head *ca.* 22.1 (—, 22.9); snout 5.87 (—, 6.55); orbit 8.8

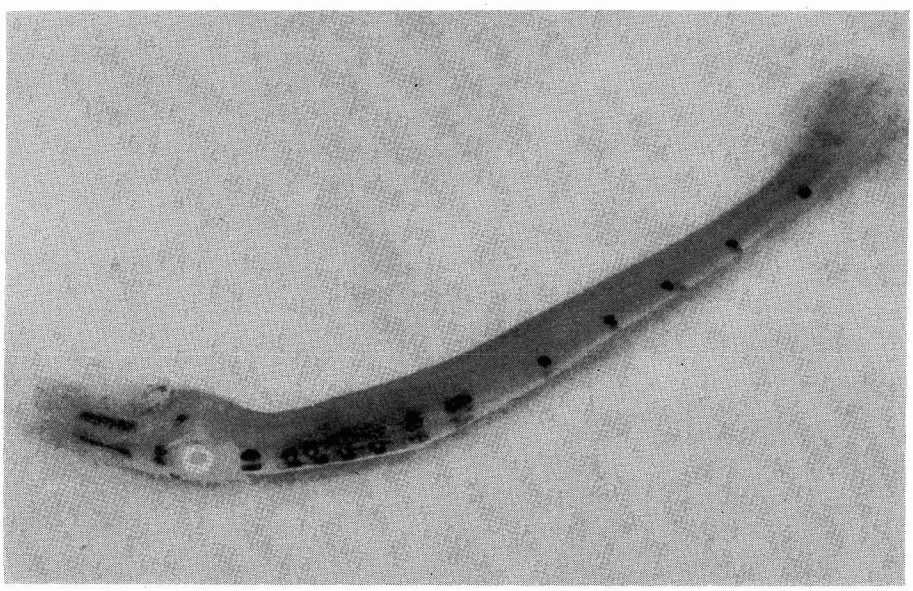

FIG. 2. *Araiophos gracilis,* holotype, ventral view.

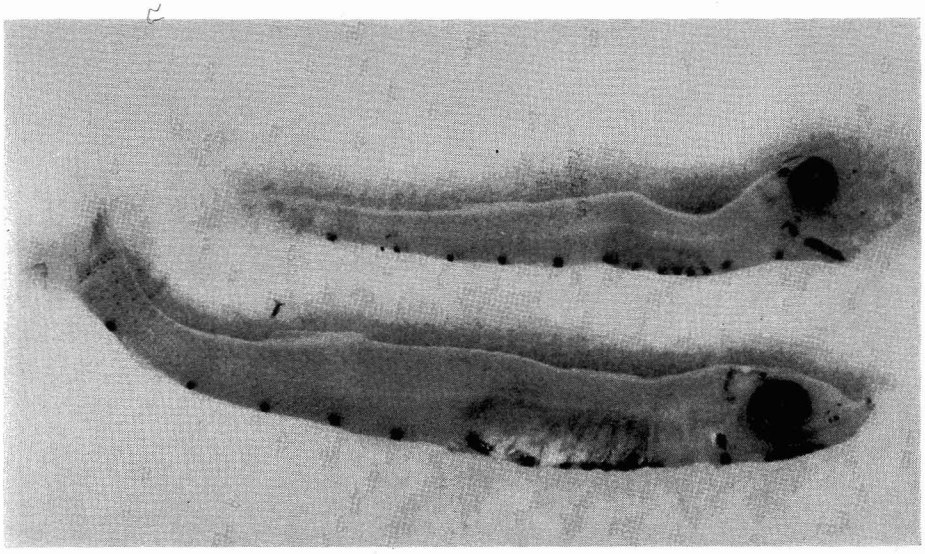

FIG. 3. *Araiophos gracilis,* paratypes, standard length 30.5 and *ca.* 23 mm.

(7.87, 6.55–8.19); interorbital width at center of eye 4.41 (4.73, *ca.* 4.9); upper jaw 13.2; premaxillary *ca.* 4.41; toothed portion of maxillary 8.8; distance between tip of snout and dorsal origin 57.3 (55.2, 57.3), anal origin 48.5 (46.6–47.3, *ca.* 49.0, and in a specimen 28 mm. long from snout to caudal 48.2–50.0), ventral base *ca.* 44.1 (*ca.* 39.4, 44.1); distance between first anal ray and base of middle caudal rays 51.4 (52.0, 49.0, and in a specimen 28 mm. long from snout to caudal 50.0), last anal ray and base of middle caudal rays *ca.* 11.7 (11.0, 14.7–16.4), last dorsal ray and base of middle caudal rays 27.9 (*ca.* 28.4, *ca.* 26.2), last dorsal ray and adipose fin 4.41 (6.3, —), ventral bases and anal origin 5.87 (4.73, 4.9); least depth of caudal peduncle 5.87 (6.3, 4.9–6.55); dorsal base 11.7 (14.2?, 11.5–13.1); anal base 38.2 (39.4, 31.1–32.8); adipose base 2.94 (6.3, —, and in a specimen 23 mm. in standard length 4.34–6.52).

Specimens all damaged to some extent, especially in head and abdominal regions; both eyes of holotype lost, this specimen otherwise in fair condition.

Body elongate, slender, compressed but with ventral surface flat between the second single abdominal IV photophore and the VAV group. No scales or scale pockets remaining. Pectoral fins of holotype reaching half-way between pectoral and ventral bases; bases broadly pedunculate. Ventral fins of holotype reaching anal origin. Adipose fin with a relatively long base; very fragile and easily lost, leaving no trace (absent on 2 specimens, tearing loose on a third, possibly incomplete on holotype); its origin above a vertical from the third single AC photophore, above end of anal fin.

Specimens too small and fragile to determine presence or absence of pseudobranchiae.

Teeth rather sparse, visible only under magnification, their presence or absence on vomer, palatines, pterygoids, or tongue impossible to determine but 1 specimen with a few minute teeth on roof of mouth anteriorly.

Photophores as in generic diagnosis. ORB minute, close to premaxillary. The single OP double, relatively large. Only (2) small IV on isthmus posteriorly, well separated from abdominal IV (no photophores between isthmus and posterior end of pectoral base); abdominal IV commencing just behind pectoral base, organs of groups (first 3 and last 2 organs) small, the 4 single organs much larger, well separated from one another. VAV occupying only anterior half of space between ventrals and anal, the individual organs very small; anus below last, thus about half-way between ventral bases and anal

origin or slightly nearer the former; number usually (4), two specimens with (4) on one side and (5) on the other, holotype with (4) on both sides. First group of AC (two organs) above fifth to seventh anal rays, last group (two organs) behind anal fin but remote from caudal base; single organs much larger than individual organs of groups; number of single organs usually 3, 3 specimens with 3 on one side and 4 on the other, holotype with 3 on both sides.

Visible inside flattened belly of most specimens are two long, narrow, whitish or yellowish masses with the appearance of testes, extending forward to third or fourth single IV photophore. In addition to these structures at least 4 specimens (24, 27.5, 27.5, 31.5 mm.) also with ovaries; eggs minute except in 24 mm. specimen, in which the ovaries are relatively large and contain eggs of different sizes.

Color in alcohol yellowish, abdomen darker. Minute brown puncticulations along mid-line on tail, and outlining myomeres of tail. A narrow vertical brown bar at extreme end of caudal peduncle. Some specimens with a short series of minute brown spots along anal base between first AC group and second single AC. Sparse brown pigment on top of head. A few minute brown spots on caudal rays, fins otherwise colorless. Inner bronzy iridescence and a few relatively large black chromatophores visible through abdominal wall laterally.

Danaphos oculatus (Garman)

MATERIAL EXAMINED: 7 specimens, 2 31.5 and *ca.* 39 mm. in standard length, others slightly shorter but too damaged to measure, collected off the Mauna Loa lava flow, Hawaii, by Moore *et al.*, June 3, 1950.

Two specimens, standard length 36.5 and *ca.* 36.5 mm., collected off the Mauna Loa lava flow, Hawaii, by Gosline *et al.*, June 6, 1950.

One specimen, standard length 33 mm., collected off the Mauna Loa lava flow, Hawaii, by Yamaguchi, June 6, 1950.

Dorsal rays 6 (4 specimens). Anal rays (23?) 24–25 (6 specimens). Pectoral rays *ca.* 18 and *ca.* 16 (2 specimens), upper 7 or 8 rays longer and much heavier than others, lowermost rays small and fine. Gill rakers on first arch 10–11 + 1 + 2 = 13–14 (2 specimens), only 1 in angle.

Measurements of 2 specimens expressed in per cent of the standard length (36.5 and 33 mm.): depth 23.3, 21.2; head 23.3–24.6, 24.2; snout 5.47, 4.54; orbit (both vertical and horizontal) 8.2, 7.55; interorbital width too narrow to be measured accurately; upper jaw —, 15.1–16.6; premaxillary 8.2–9.6, 7.55; toothed portion of maxillary 9.6–10.95, 9.06; tip of snout to dorsal origin 34.2, 34.8; to anal origin 46.5, 45.4–46.9; to ventral base *ca.* 41.0, 37.8–39.3; distance between first anal ray and base of middle caudal rays 52.0, 56.0–57.5; between last anal ray and base of middle caudal rays 8.2–9.6, 7.55; between last dorsal ray and middle caudal rays *ca.* 60.2, 53.0; least depth of caudal peduncle *ca.* 6.85, 7.55; dorsal base *ca.* 4.1, *ca.* 4.54; anal base *ca.* 43.8, 46.9; length of pectoral fin 24.6, 24.2–25.7; length of ventral fin 8.2–9.6, 9.06–10.6.

A few large, round, thin scales remaining on several specimens. Anus below third VAV, slightly nearer anal fin than ventral bases. Dorsal base very short. Anal origin close behind a vertical from last dorsal ray. No adipose fin. Pectorals, when complete, extending as far as third VAV photophore. Ventrals, when complete, reaching slightly past anal origin. Ventral bases below dorsal fin.

Photophores: No upper OP. BR (6). IV complete on only 2 specimens; (3) + (4) on isthmus, organs of first group smaller than those of second group; abdominal group 11, in 1 specimen the first one separate, connection of others not determinable; abdominal series of a second specimen separated thus: 1 + (2) + (8), the gland joining the (2) obvious on outer surface of body, the (8) seen through damaged abdomen to be joined to one another by a narrow gland, and each organ also joined to its counterpart on other side of body; total IV 17–18. VAV (5) in all 10 specimens. AC (3) + 15 + (4) + 1 = 23 in 5 specimens, (4) + 15 + (4) + 1 = 24 in 1 specimen, (3) + 14 + (4) + 1 = 22 in 1 specimen, (3) + 16 + (4) + 1 = 24 in 1 specimen, and 1 specimen with (3) + 16 + (4) + 1 = 24 on one side, (3) + 17 + (4) + 1 = 25 on other side; damaged in 1 specimen. OA (2) + 4 = 6, complete on only 1 specimen.

In alcohol, color of tail and back whitish, abdomen and head, excepting the colorless snout, blackish. Body wall along most of anal base colorless and transparent. End of caudal peduncle blackish. A series of about 28 black spots running from nape almost to caudal base.

Two specimens contain ovaries, the eggs larger in one than in the other.

D. oculatus has not been reported previously from the Hawaiian Islands although it is known to inhabit adjacent parts of the North Pacific, as well as the eastern Pacific from off Lower California to Monterey Bay.

Argyripnus atlanticus Maul
Figs. 4, 5

MATERIAL EXAMINED: 2 specimens, standard length 27 or 27.5 mm. and 35.5 mm., collected off the Mauna Loa lava flow, Hawaii, by Moore *et al.*, June 3, 1950.

Smaller specimen in poor condition; head, tail, and abdomen severely damaged; adipose fin, latter part of anal fin, last group of AC photophores, and isthmus IV mostly lost; abdominal IV damaged. Dorsal rays 12. Anal rays *ca.* 12 in front of AC group of five photophores. Pectoral fins short and fleshy, rays discernible under magnification but not clearly enough to be counted. Gill rakers on first arch 19 + 5 = 24 on left side, 19 + 6 = 25 on right side, 2 in angle. Depth 5–5.5 mm. Head and trunk shorter than tail, distance between snout and anal origin *ca.* 12–12.5 mm. and between first anal ray and base of middle caudal rays 15 mm. Anal origin below about fourth dorsal ray. BR (6). IV on isthmus (6) on one side, apparently straight, not curving upward posteriorly; abdominal IV (10), hanging loose from body, possibly incomplete. First VAV-AC group (14), probably not fully developed, first 6 or 7 in front of anal fin and larger than remainder. Middle group of AC (5). OA lost on one side of body, (2) on other side, remainder probably still undeveloped. Color in alcohol yellowish; upper half of body with a double series of small black chromatophores from nape to tail and a third, incomplete, row running posteriorly from above anal origin.

Larger specimen, 35.5 mm., in fairly good condition although difficult to measure, being bent. A few large, thin, cycloid scales remaining on back and sides. Dorsal rays 11. Anal rays 15 + 10 = 25, a short space filled with membrane below third and fourth organs of the AC group of (5), separating the two groups of rays. Pectoral rays 18. Gill rakers on first arch 19 + 6 = 25, 2 in angle.

Measurements in millimeters: depth 8; head 11; snout 2–2.5; orbit *ca.* 4; interorbital width at center of eye 2–2.5; upper jaw 7–7.5; premaxillary 3–3.5; toothed portion of maxillary 4–4.5; tip of snout to dorsal origin *ca.* 17, to anal origin 15.5, to ventral base *ca.* 12.5–13; distance between first anal ray and base of middle caudal rays 18.5–19, last anal ray and base of middle caudal rays *ca.* 6.5, last dorsal ray and base of middle caudal rays *ca.* 15; least depth of caudal peduncle 2.5–3; dorsal base 3.5–4; anal base *ca.* 11.5; pectoral length 6.5–7; adipose base 1.5; distance between VAV-AC group of photophores and group of (5) 3.5

FIG. 4. *Argyripnus atlanticus*, standard length 35.5 mm.

FIG. 5. *Argyripnus atlanticus,* standard length 35.5 mm., ventral view.

and between group of (5) and posterior AC group 3.5–4.

Premaxillary more than half as long as toothed portion of maxillary. Maxillary reaching a vertical from posterior margin of eye. Head and trunk shorter than tail. Anal origin slightly in advance of dorsal origin, which is above a vertical from about third anal ray. Adipose fin well developed, its origin above a vertical from just behind AC group of (5). Pectoral fin long, nearly reaching anal origin. Ventrals inserted well in advance of dorsal origin, ends of rays broken.

BR (6). IV (6) + (11) = 17, first organ of abdominal group directly below last organ of isthmus group, which curves upward posteriorly; individual organs of first group slightly larger than those of abdominal group. VAV-AC (21) + (5) + (17) = 43, first 7 in front of anal fin and larger than remainder, upward curve over anal fin low and gradual. IC 60. OA (2) + 3 = 5 on left side, no damage apparent, probably not fully developed; ? + 4 on right side, first organs lost but gland remaining (possibly contained 2–3 photophores).

Color in alcohol yellowish; diffuse brown pigment on caudal peduncle and nape; 3 irregular series of small black chromatophores from nape to caudal.

These two little fishes are considerbly smaller than any specimens of the genus *Argyripnus* previously reported and provide the first scant evidence of developmental changes. The larger one possibly possesses all adult characters but it seems more likely that the OA are still incomplete and that a few of the organs of the first VAV-AC group have not yet developed. One or 2 additional organs may also appear in the last group of AC, which in this little fish begins directly behind the anal fin. In all other specimens of *Argyripnus* seen or figured there are 2 to 4 of these photophores above the end of the anal fin.

Characters of the smaller specimen suggest that the middle group of 5 AC develops relatively early and that of the anterior VAV-AC group the organs in front of the anal fin appear first. In the last group of AC the posterior organs are apparently first to appear. The OA develop late, probably being still incomplete on the 35.5 mm. specimen. If the isthmus IV are actually straight on the small damaged fish, as they appear to be, the displacement upward of the posterior organs would occur after the species reaches a

standard length of about 27 mm. and before it attains 35 mm. An additional juvenile character of the smaller specimen is the short, fleshy pectoral fin.

The larger of the 2 Hawaiian specimens differs from all others of the genus *Argyripnus* in two rather important characters, the position of the anal origin in front of the dorsal origin, and the abdominal count of 11 IV. The IV photophores number (6) + (10) = 16 in almost all known specimens of the genus, the only exceptions being found on 2 western Atlantic specimens in which the counts are (6/7) + (10) = 16/17 and (6) + (9/10) = 15/16. Both of the Hawaiian specimens are otherwise very close to, and probably identical with, *A. atlanticus* Maul, a species hitherto known only from the North Atlantic. In Pacific species (*A. ephippiatus* Gilbert and Cramer, *A. iridescens* McCulloch, and an unrecorded specimen from the Philippines) the anal origin is situated below the end of the dorsal fin. In *A. atlanticus* it is below the anterior rays of the dorsal and the anal origin of the younger Hawaiian specimen is similar. The fact that the two little Hawaiian fishes differ from one another in this character suggests that the anal position may be somewhat variable. In meristic characters these specimens differ from *A. atlanticus* only in the number of photophores in the first VAV-AC group and, as noted above, these photophores are probably not fully developed on the Hawaiian fishes. If a few more photophores are still to appear in this series, both the VAV-AC and the IC counts would be within the range of the same counts of *A. atlanticus*. Evidence that a few more photophores actually are present in the adult is shown by the fact that the distance between the AC groups is proportionately greater than in any other specimens of the genus known (see Table 3).

These specimens are also like *A. atlanticus* and unlike other species in the lower and less abrupt curve in the VAV-AC series above the front of the anal fin. Their more slender bodies can certainly be attributed to their youth and the relative lengths of the trunk and tail probably also change with age. Both of the young Hawaiian fishes have a proportionately longer tail, shorter trunk, and shorter distance between the snout and ventral bases than are found in older specimens from either the Atlantic or Pacific oceans.

TABLE 1

MERISTIC CHARACTERS OF *Argyripnus* SPECIES

SPECIMENS	STANDARD LENGTH	DORSAL RAYS	ANAL RAYS	PECTORAL RAYS	VENTRAL RAYS	GILL RAKERS ON FIRST ARCH
A. atlanticus, juv. Hawaii	27–27.5	11–12	—	—	—	19+5–6=24–25
A. atlanticus, juv. Hawaii	35.5	11	15+10=25	18	—	19+6=25
A. atlanticus, type[1] eastern Atlantic	56	12	—=27	19	7	17+7=24
A. atlanticus western Atlantic	55–71	11–12	13–15+(8)9–10=22–27	(16)17–19	6–7	17–19+6–7=22–26
A. ephippiatus Hawaii	72	12	12+12=24	15	6?	13–14+5=18–19
A. ephippiatus, type Hawaii	75	11	11+11=22	15	—	14+5=19
A. ephippiatus Hawaii	80	11–12	—	15	—	13+5–6=18–19
A. iridescens[2] Australia	90–135	12–14	—=24–25	16–17	7	16+?=?
Argyripnus sp. Philippines	82	12	13+12=25	17	7	12+4=16

[1] Data from Maul, 1952: 56.
[2] From McCulloch, 1926: 169, and Norman, 1930: 299.

TABLE 2

PHOTOPHORE COUNTS OF *Argyripnus* SPECIES

SPECIMENS	STANDARD LENGTH	IV	VAV+ FIRST GROUP OF AC	POSTERIOR AC GROUP	VAV[4] +AC TOTAL	IC	OA
A. atlanticus, juv. Hawaii	27–27.5	—	(14)	—	—	—	(2)
A. atlanticus, juv. Hawaii	35.5	(6)+(11)=17	(21)	(17)	43	60	(2)+3=5
A. atlanticus, type[1] eastern Atlantic	56	(6)+(10)=16	(28)	(18)	51	67	7
A. atlanticus western Atlantic	55–71	(6/7)+(9/10)= 15–17[3]	(24–28)	(16–18)	46–51	62–67	(3–4)+3–4=7
A. ephippiatus Hawaii	72	(6)+(10)=16	(20)	(14)	39	55	(5)+2=7
A. ephippiatus, type Hawaii	75	(6)+(10)=16	(19)	(14/15)	38/39	55/56	(5)+2=7
A. ephippiatus Hawaii	80	—	—	—	—	—	(5)+2=7
A. iridescens[2] Australia	90–135	(6)+(10)=16	(20–21)	(12–14)	37–40	53–56	7
Argyripnus sp. Philippines	82	(6)+(10)=16	(18)	(12)	35	51	(5/6)+(1/2)= 7

[1] From Maul, 1952: 56.
[2] See footnote to Table 1.
[3] IV usually (6)+(10)=16; 7 in isthmus group on one side of 1 specimen only and 9 in abdominal group on one side only of a second specimen.
[4] Including middle AC group, which is always (5).

SPECIES OF *Argyripnus*

Meristic characters and some body proportions of a number of specimens of *Argyripnus* are shown in Tables 1–3. In addition to the young specimens reported here the following have been examined: *A. ephippiatus* Gilbert and Cramer, holotype, USNM no. 47708, "Albatross" sta. 3472; and two specimens, USNM no. 126079, Hawaii, "Albatross," 1902, exact data lacking (probably the specimens reported in 1905 by Gilbert). *Argyripnus* sp., USNM no. 135402, Philippines, "Albatross" sta. 5542, vicinity of northern Mindanao, 8° 48′ 30″ N., 123° 35′ 30″ E., 200 fathoms (366 m.), 1 specimen, hitherto unreported. *A. atlanticus* Maul, "Oregon," western Caribbean Sea, 1 specimen (Grey, 1960: 67); and 13 hitherto unreported specimens taken off Puerto Rico ("Oregon" sta. 2644, 2645, 2646) and north of the Bahamas "Combat" sta. 235).

Specimens of *Argyripnus* are too scarce in museum collections to allow a determination of the number of species contained in the genus but are numerous enough to show that at least 2 distinct species exist. It is equally clear that each of these 2 forms is variable but the extent and limits of the variation are not determinable. The eastern Atlantic form of *A. atlanticus*, represented by a single specimen, differs from western Atlantic specimens in having a few more anal rays, more posteriorly situated dorsal and anal fins, and a smaller mouth. *A. atlanticus* also inhabits the Pacific at Hawaii as shown above.

The second distinct form of the genus has been found so far only in the Pacific, at Hawaii, the Philippines, and Australia. As shown in Tables 1–3 these Pacific specimens show variation that may indicate specific distinction. *A. ephippiatus* Gilbert and Cramer, from Hawaii, has fewer pectoral rays than other Pacific specimens. *A. iridescens* McCulloch, from Australia, is deeper bodied than other Pacific speci-

TABLE 3

PROPORTIONS OF *Argyripnus* SPECIES EXPRESSED IN PER CENT OF STANDARD LENGTH

SPECIMENS	STANDARD LENGTH	DEPTH	HEAD	SNOUT	ORBIT	UPPER JAW
A. atlanticus, juv. Hawaii	27–27.5	18.0–20.4	—	—	—	—
A. atlanticus, juv. Hawaii	35.5	22.5	30.9	5.62–7.02	*ca.* 11.3	—
A. atlanticus, type[1] eastern Atlantic	56	26.3	30.0	—	—	—
A. atlanticus western Atlantic	55–71	23.2–*ca.* 27.6	*ca.* 28.7–*ca.* 31.9	*ca.* 5.0–6.8	10.5 to 12.1–12.9	19.0 to 20.4–21.2
A. ephippiatus Hawaii	72	—	—	—	—	—
A. ephippiatus, type Hawaii	75	26.0	*ca.* 32.0	6.65–7.32	12.0	23.3
A. ephippiatus Hawaii	80	25.6	26.2	*ca.* 6.86	13.7	22.5–25.1
A. iridescens[2] Australia	90–135	29.6	30.6	6.8	11.65	—
Argyripnus sp. Philippines	82	26.2	34.7–35.3	6.7–7.3	12.8	23.2

SPECIMENS	SNOUT TO DORSAL ORIGIN	SNOUT TO ANAL ORIGIN	SNOUT TO VENTRAL BASE	FIRST ANAL RAY TO CAUDAL BASE	LAST ANAL RAY TO CAUDAL BASE	LAST DORSAL RAY TO CAUDAL BASE
A. atlanticus, juv.	—	44.5–46.2 or 43.6–45.5	—	54.5 or 55.5	—	—
A. atlanticus, juv.	*ca.* 47.8	43.6	*ca.* 35.2–36.6	52.0–53.5	*ca.* 18.3	*ca.* 42.2
A. atlanticus eastern Atlantic	49.0	55.0	43.6	—	—	—
A. atlanticus western Atlantic	46.3–49.0[3]	46.3–47.2 to *ca.* 52.7	*ca.* 39.6–43.1	48.6 to 52.5–53.5	*ca.* 16.4–18.7	39.4 to 43.2–44.0
A. ephippiatus (72) Hawaii	—	—	—	—	—	—
A. ephippiatus, type Hawaii	41.4	54.5	46.0	48.6	17.3	*ca.* 43.4
A. ephippiatus (80) Hawaii	45.0	55.6	44.4	48.7	14.4	*ca.* 41.8
A. iridescens Australia	—	—	—	—	—	—
Argyripnus sp. Philippines	46.4	*ca.* 55.5	46.4	46.4	15.2	*ca.* 41.5

SPECIMENS	LEAST DEPTH OF CAUDAL PEDUNCLE	DORSAL BASE	ANAL BASE	ADIPOSE BASE	PECTORAL LENGTH	FIRST VAV+ AC GROUP TO MIDDLE AC GROUP	MIDDLE AC GROUP TO LAST AC GROUP
A. atlanticus, juv. Hawaii	—	—	—	—	—	—	—
A. atlanticus, juv. Hawaii	7.02–8.45	9.84–11.3	*ca.* 32.3	4.22	18.3–19.7	9.84	9.84–11.3
A. atlanticus eastern Atlantic	11.2	—	—	—	23.2	—	—
A. atlanticus western Atlantic	7.04–9.32	11.9–13.2	30.0–33.9	*ca.* 5.8–10.5	18.9–24.4	3.79 to 5.3–6.0	6.9–9.06[5]
A. ephippiatus (72) Hawaii	—	—	—	—	—	2.78	7.65
A. ephippiatus, type Hawaii	8.65	14.0	*ca.* 31.3	*ca.* 8.0	—	—	8.0
A. ephippiatus (80) Hawaii	9.36	10.85	33.1	10.0	25.0	*ca.* 4.37	*ca.* 8.25
A. iridescens Australia	—	—	—	—	24.3	—	—
Argyripnus sp. Philippines	9.14	12.2	31.5	—[4]	21.9	3.05	7.33

[1] Calculated from measurements given by Maul, 1952: 56.
[2] Calculated from measurements given for a single specimen by McCulloch, 1926: 169.
[3] 42.7 and 43.0–43.9 in 2 specimens 55 and 57 mm. in standard length.
[4] Upper surface of tail damaged, adipose fin lost.
[5] 10.0–10.9 in smallest specimen (55 mm.).

mens and may have more gill rakers, although information on the total number of rakers on the first arch of this species is lacking. The single specimen of *Argyripnus* from the Philippines is unique in a few characters. Because of these unique features and because it is the only specimen to have been caught between Hawaii and Australia, the specimen is not identified to species at the present time, although it was originally labeled *"Argyripnus iridescens"* and is catalogued under that name in the collection of the U. S. National Museum.

A few minor errors appeared in the original description of *A. ephippiatus* (Gilbert and Cramer, 1896: 414) and may be corrected as follows: dorsal rays 11 (not 10); BR (6) (not 5); AC in the most posterior group (15) on the left side and (14) on the right side; adipose fin present and undamaged.

The smallest of the 3 specimens of *A. ephippiatus* examined is bent and cannot be measured accurately. The photophores of this specimen and of the holotype are intact, but many of those of the largest specimen are lost (abdomen and ventral portion of tail damaged). In all 3 specimens the tail is a little shorter than the trunk; the anal origin is below the end of the dorsal fin; there is a distinct gap, filled with membrane, between the two groups of anal rays in the holotype and the smallest specimen; the unbroken pectoral fin of the largest fish extends to a point half-way between the ventral and the anal fins. The pseudobranchiae are well developed; on the inner edge of the first gill arch is a series of groups of minute spines and 1 or 2 slightly enlarged spines on the upper limb near the angle. The maxillary reaches the posterior margin of the orbit; 1 or 2 very small teeth are present on each side of the vomer; and on each palatine, anteriorly, are a few still smaller teeth. *A. ephippiatus* differs from *A. atlanticus* in having fewer gill rakers and fewer photophores in the ventral series. It is unique in its lower pectoral count and in having 1 or 2 slightly enlarged spines on the inner edge of the upper limb of the first gill arch.

The specimen from the Philippines has the tail a little shorter than the trunk; the anal origin is below the end of the dorsal fin; there is a short gap between the two groups of anal rays, situated below the third organ of the middle AC group of 5; the pectoral fin extends slightly beyond the ventral base; the back is damaged and the adipose fin is lost. The pseudo-

KEY TO SPECIES OF *Argyripnus*

1a. Anal origin below first few dorsal rays, or slightly anterior to dorsal origin. Gill rakers on first arch 17–19 + 5–7 = 22–26. VAV + AC (24–28) + (5) + (16–18) = 46–51. IC 62–67 ..... *A. atlanticus* Maul
North Atlantic, Hawaii

1b. Anal origin below posterior half of dorsal fin. Gill rakers on first arch 12–16 + 4–6 = 16–19 (20 + ?).[2] VAV + AC (18–21) + (5) + (12–15) = 35–40. IC 51–56.

2a. Gill rakers on lower limb of first arch 13–16. First group of VAV + AC (19–21). IC 53–56. Head 2.6 to *ca.* 3.8 times in standard length.

3a. Pectoral rays 16–17. Depth 3.1–3.4 times in standard length. Orbit 2.5–2.7 times in head length ..... *A. iridescens* McCulloch
Australia

3b. Pectoral rays 15. Depth 3.8–3.9 times in standard length. Orbit 1.9–2.25 times in head length ..... *A. ephippiatus* Gilbert and Cramer
Hawaii

2b. Gill rakers on lower limb of first arch 12. First group of VAV + AC (18). IC 51. Head 3.85 times in standard length (depth 3.8 times in standard length. Orbit 2.7–2.75 times in head length) ..... *Argyripnus* sp.
Philippines

[2] *A. iridescens* with 16 on lower limb; number on upper limb, and total count, unknown.

branchiae are well developed; on the inner edge of the first gill arch is a series of minute spine-clusters but no enlarged spines are present. The maxillary extends to the posterior margin of the orbit; 1 tooth is present on each side of the vomer; 1 minute tooth can be seen anteriorly on each palatine. This specimen differs from *A. atlanticus* in the same characters that distinguish *A. ephippiatus* from that species. It is unique in its low gill raker and photophore counts and its relatively large head.

A description of the western Atlantic specimens of *A. atlanticus* is being published elsewhere.

REMARKS ON MAUROLICID GENERA

The discovery of 2 young specimens of *Argyripnus* and of a new maurolicid genus requires a partial revision of my key to gonostomatid genera published in 1960. Until relationships within the family are better understood, a number of monotypic genera are maintained, however reluctantly, although some of them may prove to be synonymous. For example, *Thorophos, Neophos,* and *Araiophos* may represent 3 species of a single variable genus, but until the characters separating them can be shown to be of specific rather than of generic value it seems advisable to place them in separate genera. Larger series of specimens, the discovery of post-larval stages, and possibly an understanding of their ecology should one day provide the basis for a more definitive classification. In the meanwhile *Neophos* remains separate from *Thorophos* principally on the basis of the biserial premaxillary teeth; the only other genera in the family with 2 rows of teeth on the premaxillary bones are *Yarrella, Triplophos,* and *Polymetme. Neophos* also differs from most maurolicids in having a body form similar to that of several nonmaurolicid genera; only *Araiophos,* among maurolicids, is similarly slender-bodied anteriorly and thus atypical of the group with which it is classified. *Araiophos* is unique in the form and arrangement of the IV photophores, which consist of 2 minute grouped organs on the isthmus, and on the abdomen four large, well-separated organs preceded by a group of 3 tiny photophores and followed by a group of 2 small ones. The abdominal IV show no such differentiation in any other genus in the family.

The 2 genera *Sonoda* and *Argyripnus* may also prove to be synonymous. *Sonoda paucilampa* Grey (1961), a species found recently in the western Atlantic, is in some respects intermediate between the 2 genera; and the discovery at Hawaii of an *Argyripnus* with the anal origin anterior to the dorsal origin, as it is in *Sonoda,* further narrows the gap between the 2 genera.

Material used in the preparation of the following key, in addition to that reported here and in 1960, included a single damaged specimen of *Thorophos euryops* Bruun from "Dana" sta. 3736-v, 9° 17′ N., 123° 58′ E., 28 June 1929, 1000 m. of wire out; and 6 specimens of *Neophos nexilis* Myers, USNM no. 151400, from off Mindanao, Philippines, "Albatross" sta. 5516, 8° 46′ N., 123° 32′ 30″ E., 9 August 1909, 175 fathoms (320 m.).

KEY TO MAUROLICID GENERA OF GONOSTOMATIDAE

1a. AC composed mostly of separate photophores, more or less evenly spaced, usually one or two groups of 2–4 small organs included (always at least 3 separate organs).

2a. Anal origin in advance of dorsal origin. Ventral bases well ahead of dorsal origin. IV on isthmus straight, none curving upward posteriorly. Total number of AC 7–15. IC 22–37. Dorsal rays 8–14. Anal rays 28–38. Gill rakers on first arch 13–15 + 3–5 = 18–19, 2 in angle.

3a. Maxillary reaching to or beyond posterior margin of eye. Anus closer to anal fin than to ventral bases. Dorsal rays 8–11. Anal rays 31–38. OP 3. SO present. Number of IV on isthmus 6, IV present below pectoral base, total number of IV 17. AC present above the most anterior anal rays, total number 13–15. IC 35–37. OA present. (AC mostly single.)

4a. Premaxillary teeth biserial. Lower jaw teeth biserial in anterior half. Dorsal origin about in middle of body length. No adipose fin. Dorsal rays 8–9. Anal rays 38. IV on isthmus 1 + (2) + (3) = 6. VAV 1 + (3) + 1 = 5. OA 1 ..... *Neophos* Myers

4b. Premaxillary teeth uniserial. Lower jaw teeth uniserial?[3] Dorsal origin slightly behind middle of body length. Adipose fin present. Dorsal rays 11. Anal rays 31. IV on isthmus 3 + (3) = 6. VAV (5). OA (2) + 5 = 7..... ..... *Thorophos* Bruun

3b. Maxillary reaching slightly past middle of eye. Anus half-way between ventral bases and anal origin or slightly nearer ventral bases. Dorsal rays 13–14. Anal rays 28–29. OP 1. SO absent. Number of IV on isthmus (2), no IV below pectoral base, total number of IV 11. AC absent above the most anterior anal rays, total number 7–8. IC 22–23. No OA. (Dorsal origin well behind middle of body length. Adipose fin present.) ..... ***Araiophos,*** new genus

2b. Anal origin behind or below last dorsal ray. Ventral bases below dorsal fin. IV on isthmus curving upward posteriorly. Total number of AC 22–26. IC 45–49. Dorsal rays 6. Anal rays 24–25. Gill rakers on first arch 10–12 + 1 + 2 = 13–15, only 1 in angle. (Dorsal origin well in advance of middle of body length. Anus about half-way between ventral bases and anal fin or slightly nearer anal. Adipose fin present or absent. SO absent. Total number of IV 18, (3) + (4) on isthmus. AC present above the most anterior anal rays. Vertebrae 38.) ..... *Danaphos* Bruun

1b. AC composed of 2 to 5 groups of 2 or more photophores each (1 separate organ present anteriorly only in *Maurolicus*). (Two gill rakers in angle of first arch.)

5a. AC in 3 to 6 groups of 2 to 4 small photophores each. IV (3) + (4) on isthmus, (16–17) on abdomen, total 23–24. VAV (4–5). Gill rakers on first arch 12 + 2–3 = 14–15. (Anal origin below or slightly in advance of dorsal origin. Adipose fin present. Anus closer to anal origin than ventral bases. No SO. No AC above the most anterior anal rays. Vertebrae 32–33?.) ..... *Valenciennellus* Jordan and Evermann

5b. AC in 2 or 3 groups of 5 or more photophores each. IV (6, rarely 7) on isthmus, (10–13) on abdomen, total 16–19. VAV (6–8), *or* joined to anterior group of AC (*Argyripnus*). Gill rakers on first arch 12–22 + 3–8 = 16–30.

6a. Anus about half-way between ventral bases and anal fin or nearer ventrals. Dorsal origin about in middle of body length. SO absent. Lower posterior OP greatly enlarged. IV (6, rarely 7) + (10, rarely 9 or 11) = 16 (rarely 15 or 17). Total number of OA 6–7.

7a. No adipose fin. VAV (7–8), well separated from AC. AC in 2 long groups or 3 short groups, absent above the most anterior anal rays. Dorsal rays 8–9. (Vertebrae 40 and ?.) ..... *Sonoda* Grey

7b. Adipose fin well developed. VAV grouped with photophores above the most anterior anal rays, this group numbering (18–28) in adult. Dorsal rays 10–14. (Vertebrae 47 and ?.) ..... *Argyripnus* Gilbert and Cramer

6b. Anus near anal fin. Dorsal origin well behind middle of body length. SO present. Lower posterior OP of normal size. IV (6) + (12–13) = 18–19. Total number of OA 9 (rarely 10). (Adipose fin present. AC present above the most anterior anal rays, in 2 groups of (14–18) and (7–9) photophores, preceded by a single elevated organ. Vertebrae 32–33.) ..... *Maurolicus* Cocco

[3] Premaxillary and lower jaw bones lost from only specimen of *Thorophos* examined.

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